PHYSICS AND STATISTICS

I Year	Scientific Field	DISCIPLINE	TUTOR
Physics and Statistics	FIS/07	*Applied Physics*	**Nicola Toschi**
	INF/01	*Informatics*	**Maria Giovanna Guerrisi**
ECM 12	MED/01	*Statistics*	**Simona Iacobelli**
Coordinator			
Nicola Toschi			

Specific aims

Acquiring basic knowledge of the main physical and statistical principles as well as their applications in medicine. Improving the student's ability to the scientific data analysis and quantitative investigation by solving simple problems relevant to the course topics.

PROGRAM

a) Physics Mechanics: Measurement, Estimating, SI Units and Dimensions, Vectors, Kinematics in one and two Dimensions, Velocity, Acceleration, Kinematics of Uniform Circular Motion, Dynamics: Newton's Laws of Motion, Weight-The Force of Gravity; and the Normal Force, Work and Energy: Work Done by a Constant or Varying Force, Kinetic Energy and the Work-Energy Principle, Potential Energy, Conservative and Non-conservative Forces, Mechanical Energy and its Conservation, Power, Linear Momentum: Momentum and Its Relation to Force, Elastic and Inelastic Collisions, Center of Mass (CM), CM of the Human Body, Center of Mass and Translational Motion, Rotational Motion, Torque, Rotational Dynamics; Torque and Rotational Inertia, Static Equilibrium; The Conditions for Equilibrium, Applications to Muscles and Joints, Stability and Balance. Elasticity: Static Equilibrium of Deformable Bodies, Stress and Strain, Tensile and Compressive Stress-Strain Relationships, Young' s Modulus, Viscoelasticity, Energy Storage in Elastic Media, Bending of a Beam, Fractures, Elastic Properties of Biomaterials: Bone, Blood Vessels, Lungs, Ligaments and Tendons. Elastic Membranes: Elastic Tension and Laplace Law, Applications to Cardiac Mechanics. Forces Acting on a Blood Vessel, Forces Acting within a Brain Aneurysm. Fluids: Phases of Matter, Density and Specific Gravity,Pressure in Fluids,Atmospheric Pressure Gauge Pressure,Pascal's Principle, Measurement of Pressure; Gauges and the Barometer,Examples of Pressure in Human Organs, Buoyancy and Archimedes' Principle,Fluids in Motion; Flow Rate and the Equation of Continuity,Bernoulli's Principle, Viscosity,Laminar Flow in Tubes: Poiseuille's Equation, Turbolent Flow; Applications to Cardiovascular System: Overwiew of Circulatory System and Cardiac Cycle, Blood Pressure and its measurement, Blood Flow Rates and Speeds in Vessels, Stenosis and Aneurysms, Work Done by the Heart, Intravenous infusion, Physiological Effects of Hydrostatic Pressure, Fluid Dynamics of respiration Cohesive forces in liquids: Surface Tension, Contact Angles and Capillarity, Laplace's Law, Surfactant in the Lungs.
Thermodynamics: Temperature and Kinetic Theory Atomic Theory of Matter, Temperature and Thermometers,Thermal Equilibrium and the Zeroth Law of Thermodynamics,Thermal Expansion,The Gas Laws and Absolute Temperature,The Ideal Gas Law Problem Solving with the Ideal Gas Law Ideal Gas Law in Terms of Molecules: Avogadro's Number Kinetic Theory and the Molecular Interpretation of Temperature Heat as Energy Transfer Internal Energy Specific Heat Calorimetry Latent Heat Heat Transfer: Conduction Heat Transfer: Internal Energy Energy Specific Heat Calorimetry Latent Heat Heat Transfer:

Heat Transfer: Convection Heat Transfer: Radiation The Laws of Thermodynamics The First Law of Thermodynamics Thermodynamic Processes and the First Law Human Metabolism and the First Law Second Law of Thermodynamics-Introduction Entropy and the Second Law of Thermodynamics Electricity and Magnetism Electricity and Magnetism: Electric Charge and Electric Field,Static Electricity; Electric Charge and its Conservation, Coulomb's Law The Electric Field Electric Fields and Conductors, Gauss's Law,Electric Forces in Molecular Biology: DNA Structures and Replication,Electric Potential, Electric Potential Energy and Potential Differences,Capacitance, Dielectrics The Electrocardiogram (ECG or EKG),Electric Currents Ohm's Law: Resistance and Resistors Resistivity Electric Power,Electrical Conduction in the Human Nervous System DC Circuits EMF and Terminal Voltage,Resistors in Series and in Parallel Kirchhoff's Rules EMFs in Series and in Parallel; Charging a Battery Circuits Containing Capacitors in Series and in Parallel RC Circuits-Resistor and Capacitor in Series Electric Hazards ;Magnetism Magnets and Magnetic Fields, Electric Current Produce Magnetic Fields, Force on an Electric Current in a Magnetic Field: Definition of B, Force on a Electric Charge Moving in a Magnetic Field,Ampere's Law, Torque on a Current Loop; Magnetic Moment Mass Spectrometer ;Electromagnetic Induction and Faraday's Law Induced EMF.
Faraday's Law of Induction; Lenz's Law EMF Induced in a Moving Conductor Changing Magnetic Flux Produces an Electric Field Vibrations and Waves Wave Motion Types of Waves: Transverse and Longitudinal Energy Transported by Waves Intensity Related to Amplitude and Frequency Reflection and Transmission of Waves Interference; Principle of Superposition Standing Waves; Resonance Electromagnetic Waves Changing Electric Fields Produce Magnetic Fields; Maxwell's Equations Production of Electromagnetic Waves Light as an Electromagnetic Wave and the Electromagnetic Spectrum Energy in EM Waves ;The Wave Nature of Light The Visible Spectrum and Dispersion Nuclear Physics and Radioactivity: Early Quantum Theory and Models of the Atom Discovery and Properties of the Electron, Planck's Quantum Hypothesis; Blackbody Radiation,Early Models of the Atom, Atomic Spectra: Key to the Structure of the Atom The Bohr Model Nuclear Physics and Radioactivity Structure and Properties of the Nucleus Binding Energy and Nuclear Forces Radioactivity Alpha Decay Beta Decay Gamma Decay Conservation of Nucleon Number and Other Conservation Laws Half-Life and Rate of Decay Calculations Involving Decay Rates and Half-life Decay Series Radioactive Dating Detection of Radiation Nuclear Energy; Effects and Uses of Radiation: Nuclear Reaction and the Transmutation of Elements Passage of Radiation Through Matter; Radiation Damage Measurement of Radiation- Dosimetry Radiation Therapy Tracers and Imaging in Medicine Emission Tomography Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI) b) Statistics Introduction to Statistics and the use of Statistics in Medicine (Evidence-Based Medicine / Nursing / Prevention). Quantitative knowledge of phenomena with variability. Elements of descriptive statistics. Main concepts and terminology; classification of variables and their coding. Frequency distributions, syntheses and graphical representations; position and variability indexes (arithmetic mean, weighted mean, median and quantiles, ranges, standard deviation, variance and variation coefficient). Statistical indexes in relation with the shape of the distribution (symmetry, skewness, multiple modes).
Elements of probability theory. Events and definition of probability; conditional probability; basic rules of probability theory; Bayes.
formula. Applications. Diagnostic test (concept of sensitivity, specificity, predictive value of the test). Main probability distributions.
and their use in applications: Binomial, Poisson, Normal. Measures for comparing two groups: Risk Ratio, Odds Ratio, Rate Ratio.
Elements of frequentist statistical inference. Framework and repeated sampling principle; the distribution of the sample mean.
Point estimation; main properties of estimators. Interval estimation via confidence intervals. concepts and basic elements of statistical testing; type I and II error, rejection regions, significance (p-value). Examples: T-test for the mean and the proportion.
Statistical tests for studying associations: T-test for means and Chi-Squared for contingency tables. Notions of further

COURSE OF MEDICINE AND SURGERY
Student Handbook a.y. 2014-2015

Textbooks

A) Physics
Douglas C. Giancoli: "PHYSICS: Principles with Applications" Sixth edition, Pearson Education. Inc, ISBN 0-13-060620-0
J.W. Kane & M.M. Sternheim: "Physics" Third edition, John Wiley & Sons, ISBN 047185221X
B) Statistics
Slides and a series of exercises (with solutions) (http://www.uniroma2.it/didattica/).
Medical statistics at a glance, by A Petrie & C Sabin, Ed. Wiley-Blackwell
An introduction to medical statistics, by M Bland, Oxford Medical Publications

EXAM METHOD

You will be required to attend independent examinations for both the Physics and the Statistics courses. You will
be able to take both the Physics and Statistics exams either a) during the same exam session or b) during separate
exam sessions, as long as both exams are taken within the same academic year.
You will receive a single grade for the Integrated Course in Physics and Statics, which will be calculated as a weighted average of the two grades obtained in Physics and Statistics. The weights will be the credit hours assigned to each course.
Final Physics and Statistics grade = (0.7 Physics grade) + (0.3 Statistics grade)
A) Physics
You will undergo a written assessment composed of multiple choice questions and problems. If your score is:
- Below 15: exam failed
- Between 15 (included) and 17 (included): attend compulsory oral examination or withdraw (exam failed)
- 18 or more: keep this as your final grade or attend optional oral examination

EXAM COMMISSION

Nicola Toschi (President)	
Maria Giovanna Guerrisi	
Simona Iacobelli	

Tutor

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